Prevalence of clinical signs of intra-articular temporomandibular disorders in children and adolescents

A systematic review and meta-analysis

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Temporomandibular disorders (TMDs) can be defined as a variety of clinical conditions affecting the masticatory muscles, the temporomandibular joint (TMJ), and associated structures.[1] Muscles and TMJ pain, muscle sensitivity through palpation, restricted mouth opening, asymmetric mandibular movements, and joint sounds are among the main signs and symptoms of TMD.[2] The etiology of TMD may be related to parafunctional habits, trauma, genetics, or anatomic problems, and may be triggered by psychosocial factors.[3]

Supplemental material is available online.

The prevalence of TMD usually is expressed in percentages of people who have signs and symptoms of TMD or who have a TMJ condition that registers on an anamnestic or clinical dysfunction index.[4] The prevalence of TMD varies widely, likely owing to methodological differences among studies, such as lack of standardization related to TMD diagnosis or related to participant selection from clinical practices and not from the general population.[5]

The investigators of a study in children with primary dentition reported a prevalence of 34.0% of TMD signs, symptoms, or both.[6] Furthermore, among studies

ABSTRACT

Background. The aim of this systematic review and meta-analysis was to assess the prevalence of clinical signs of temporomandibular joint (TMJ) disorders in children and adolescents.

Type of Studies Reviewed. The authors selected only studies in which the investigators' primary objective was to evaluate the prevalence of signs of TMJ disorders according to the international Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) in children and adolescents. The authors performed electronic searches without language restriction in 5 databases. The authors also assessed quality.

Results. In this review and meta-analysis, the authors included 11 articles that described studies in which 17,051 participants had been enrolled. The overall prevalence of clinical signs of intra-articular joint disorders was 16% (95% confidence interval [CI], 11.59-19.94; n = 17,051). The prevalence of TMJ sounds (click and crepitation) was 14% (95% CI, 9.67-19.79; n = 11,316). The most prevalent sign was clicking (10.0%; 95% CI, 7.97-12.28; n = 9,665) followed by jaw locking (2.3%; 95% CI, 0.56-5.22; n = 5,735).

Conclusions and Practical Implications. One in 6 children and adolescents have clinical signs of TMJ disorders. The results of this systematic research study can alert dentists about the importance of looking for signs of TMD in children and adolescents.

Key Words. Evidence-based dentistry; prevalence; children; adolescents; temporomandibular joint disorders.
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related to TMJ disorders in children and adolescents, investigators reported the prevalence of clicking as 2.7% in the primary dentition, 10.1% in late mixed dentition, and 16.6% in permanent dentition.[7] The most frequent clinical signs found in children and adolescents are TMJ sounds (perceived on palpation), limitation of mandibular movements, masticatory muscle pain, and TMJ tenderness.[8]

In 2013, the investigators of a systematic review of the prevalence of TMD signs and symptoms in children reported a prevalence varying from 16.0% to 68.0%.[9] However, the authors of this review reported only the prevalence of masticatory muscle signs and symptoms and did not look for TMJ intra-articular disorders. TMJ disorders are internal derangements defined as mechanical failures related to a malposition of the articular disk associated with interferences in normal mandibular movements.[10] This topic is especially important to clinicians who are in the process of clinical decision-making for patients in pediatric populations. Notwithstanding that, to our knowledge, no summary data are available, and the reported prevalence rates published in textbooks have been made on the basis of findings from a few large-scale epidemiologic research studies.

Dentists should try to identify these signs and screen children and adolescents with intra-articular TMD so that proper clinical follow-up can be provided. We determined that, on the basis of our review of this background information, we would conduct a systematic review with the aim of reporting the prevalence of clinical signs of TMD in children and adolescents.

METHODS

Protocol and registration. This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis checklist.[11] We registered the systematic review with PROSPERO: International Prospective Register of Systematic Reviews (Centre for Reviews and Dissemination, University of York, Heslington, York, United Kingdom; and the National Institute for Health Research, London, United Kingdom) under registration number CRD42015016100.

Eligibility criteria. ***Inclusion criteria.*** We determined that the only articles that were eligible for the study were those for whom the authors had investigated the prevalence of clinical signs of TMJ disorders in children and adolescents (aged 0-18 years). We included studies whose authors evaluated TMJ signs according to the Research Diagnostic Criteria for Temporomandibular Disorders[10] (RDC/TMD) established by the International RDC/TMD Consortium Network of the International Association for Dental Research and the Orofacial Pain Special Interest Group[10] or by using similar criteria even if they had not referenced the criteria as being RDC/TMD. We considered for inclusion studies whose authors evaluated the following signs: TMJ noise (for example, click, pop, snap, or crepitus), jaw locking or catching, or both. Also, we considered for inclusion only studies whose reports included a dentist's clinical examination, as well as an evaluation of TMJ sounds conducted without the aid of a stethoscope and through the study participant's repeated movements (at least 3 times) of mouth opening. We did not apply any language restrictions.

Exclusion criteria. We excluded studies according to the following criteria: reviews, letters, conference abstracts, and expert opinions; studies in which members of the sample had craniofacial anomalies, genetic syndromes, or neuromuscular diseases; studies with participants who were undergoing active orthodontic treatment or participants whose conditions indicated a need for orthognathic surgery; studies in which the investigators had not conducted the face-to-face interviews (for example, investigators conducted interviews by phone or mail); studies whose participants were adults ($\geq$ 19 years old); studies whose authors investigated only muscular symptoms; studies in which a dentist did not conduct the interview, the examination, or both; studies whose authors did not perform the same protocol as that described by RDC/TMD; studies whose authors used convenience samples extracted from patients in treatment in dental clinics or hospital; and studies whose authors used samples of fewer than 300 participants.

Information sources. With the help of a health sciences librarian (M.G.S.), we selected appropriate truncation and word combinations and adapted them for each database search. We developed detailed, individualized strategies for each of the following bibliographic databases: the Cochrane Library, MEDLINE, Embase, PubMed, and LILACS. (More information on the search strategies is provided in eTable 1, available online at the end of this article.) We undertook a partial gray literature search through Google Scholar. We also hand searched the reference lists cited in the included articles for any additional references that might not have been identified during the electronic database searches.

Search. We managed the references and removed the duplicates by using appropriate software (RefWorks-COS, ProQuest). We conducted all the electronic database searches from their starting coverage date through October 15, 2014.

Study selection. We selected the final articles through a 2-phase process. In phase 1, 2 investigators (C.G.S. and C.P.-P.) independently screened the titles and abstracts of all identified references. In this phase, they excluded

ABBREVIATION KEY. **DC/TMD:** Diagnostic Criteria for Temporomandibular Disorders. **JIA:** Juvenile idiopathic arthritis. **RDC/TMD:** Research Diagnostic Criteria for Temporomandibular Disorders. **TMD:** Temporomandibular disorders. **TMJ:** Temporomandibular joint.

articles that did not meet the inclusion criteria. In phase 2, the same investigators (C.G.S. and C.P.-P.) applied the inclusion criteria to the full text of the articles. These 2 authors resolved any disagreement in both phases by discussion until they attained mutual agreement. When they needed help making a final decision, a third author (G.L.C.) participated in the review process. They based their final selections solely on the full-text assessment of the studies.

Data collection process. Next, 1 author (C.G.S.) performed the data extraction from the included articles, and a second author (C.P.-P.) cross-checked all the retrieved information. Again, these 2 authors resolved any disagreement by discussion until they reached mutual agreement. A third author (G.L.C.) was involved, when required, to make a final decision.

Data items. For each of the included studies, these authors extracted key features, such as author, year of publication, sample origin and size, demographic features, results, and conclusions related to TMJ signs in children and adolescents. If the required data were not complete, the authors attempted to contact the authors to retrieve any pertinent unpublished information.

Risk of bias in individual studies. We evaluated the methodological quality of selected studies by using a validated instrument[12] that specifically assesses the prevalence of disorders in studies with nonstandardized examination and diagnostic protocols. This method, which is conducted on the basis of strict epidemiologic criteria, allows reviewers to extract data from studies according to several items such as number and characteristics of participants, interrater agreement, response rate, and measurement methods. The quality assessment mainly is divided into 3 categories: sampling, measurement, and analysis. The final quality score assigned to the included studies indicated the sum of designated points (maximum of 20) as poor, moderate, good, and outstanding.

Summary measures. We considered any type of prevalence outcome measurement that presented the prevalence of TMJ intra-articular disorder signs in children or adolescents.

Synthesis of results. To decrease the heterogeneity among studies, we separated the results according to the signs that investigators analyzed. These signs were joint sounds (click or crepitation), clicking, and jaw locking. The heterogeneity that we found among the study results in the meta-analysis was high; therefore, we chose to use a random-effects model. We used MedCalc (MedCalc Software) to perform the meta-analysis. We set the significance level at 5%.

Risk of bias across studies. We assessed the clinical heterogeneity (by comparing variability among the participants' characteristics and the outcomes studied), methodological heterogeneity (by comparing the variability in study design and the risk of bias), and statistical heterogeneity.

RESULTS

Study selection. We identified 1,356 citations across the 5 electronic databases. When we removed duplicate articles, 800 citations remained. In phase 1 (screening phase), we performed a comprehensive evaluation of the abstracts that excluded 613 articles, resulting in 104 articles. Also, we identified 4 studies from Google Scholar. We identified 14 additional studies from the reference lists of these studies, but we included only 2 of them, making a total of 110 studies to be considered in phase 2. Thereafter, we excluded 99 studies owing to various reasons (eTable 2, available online at the end of this article). We included only 11 articles in the final qualitative and quantitative synthesis. All included studies were from the main electronic search. Figure 1 shows a flowchart describing the process of identification, inclusion, and exclusion of studies.[11]

Study characteristics. Of the 11 selected studies, 2 articles were from Israel,[13,14] 3 were conducted in Saudi Arabia,[15-17] and the other 6 were conducted in various countries, including Colombia,[7] China,[18] Finland,[19] Germany,[20] Italy,[21] and the United States.[22] Sample sizes ranged from 314[14] to 4,724[7] study participants. The investigators of only 2 studies[20,21] reported that they had used the RDC/TMD protocol, and the investigators of the other studies used a protocol that was in some way similar to the RDC/TMD protocol.[7,13-19,22] The investigators of all 11 studies individually evaluated some TMD signs. The investigators of 5 studies[13,15,18,19,22] evaluated only TMJ sounds, including clicking, crepitation, or both. The investigators of 6 studies[7,14,16,17,20,21] evaluated TMJ sounds and limited mouth opening. The table[7,13-22] summarizes the descriptive characteristics of the studies.

Risk of bias within studies. The studies were not homogeneous. We classified 1 study[13] as poor because of the methodological quality assessment the authors had applied, 2 studies[14,18] as moderate, 5 studies[7,15,17,19,21] as good, and 3 studies[16,20,22] as outstanding. The table[7,13-22] and eTable 3[7,12-22] (available online at the end of this article) provide more information about the risk of bias among the studies.

Risk of bias across studies. In eTable 3[7,12-22] (available online at the end of this article), we list a complete analysis of the quality assessment items. The main methodological limitations of the studies related to the lack of information provided about the target population and the response rate. Furthermore, another important criterion responsible for the differences in quality among the studies was having received approval from an ethics commission.

Results of individual studies. Among the study results, we noted differing prevalence values for TMJ sounds on palpation, ranging from 4.0%[21] to 42.7%.[14]

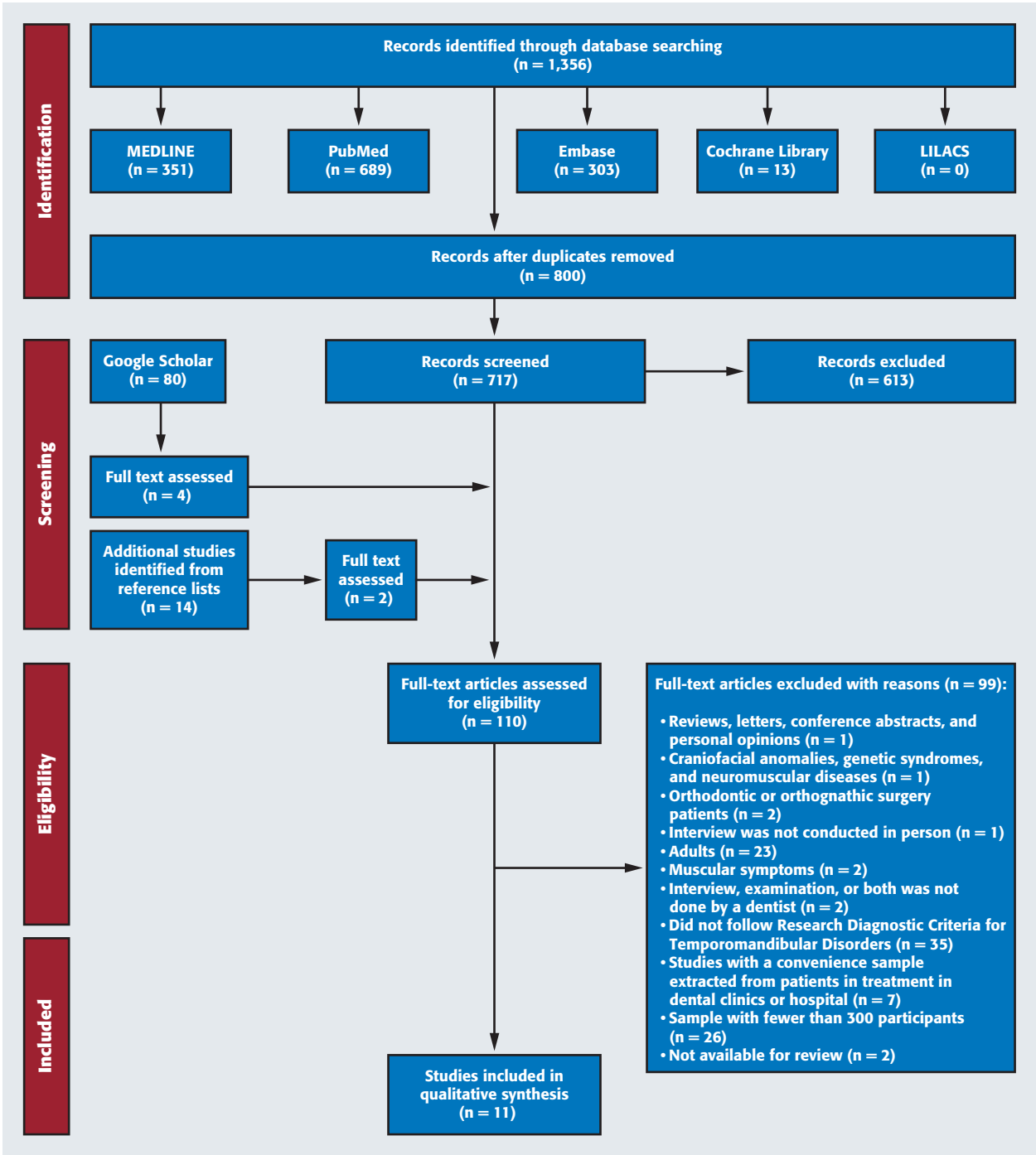

Figure 1. Flow diagram of literature search and selection criteria. Some articles were excluded for more than 1 reason. *Source: Moher and colleagues.*[11]

Four studies[7,15,20,22] clustered the prevalence values of TMJ sounds in separated groups of clicking and crepitation sounds. The lowest prevalence value for clicking in the TMJ was 7.6%,[15] and the highest value was 14.7%.[20] The values of crepitation were low and represented 0.2% and 1.0%, found among 2 studies, respectively.[15,22]

The prevalence of restricted mouth opening, jaw lock, or luxation varied from 0.4%[7] to 5.9%.[16] Only 2 studies

reported prevalence of jaw lock, and the results were 1.3%[7] and 3.7%.[20] The prevalence of limited mouth opening varied from 1.1% to 5.9%.[14,16,17,21] Only 1 study[7] reported the prevalence of luxation (0.4%).

Synthesis of results. We grouped the 11 selected studies and performed a meta-analysis. We found a high level of heterogeneity among the studies; therefore, we chose to perform a meta-analysis using a random-effects model.[23] The results from this meta-analysis showed that the overall prevalence of clinical signs of intra-articular joint disorders was approximately 16.0% (95% confidence interval [CI], 11,596-19,947; n = 17,051; Figure 2A[7,13-22]). The prevalence of TMJ sounds (click or crepitation) was approximately 14.0% (95% CI, 9,678-19,797; n = 11,316; Figure 2B[13-19,21,22]). The most prevalent sign was click, at 10.0% (95% CI, 7,975-12,288; n = 9,665; Figure 2C[7,15,20,22]) followed by jaw locking, at 2.3% (95% CI, 562-5,221; n = 5,735; Figure 2D[7,20]).

DISCUSSION

In this systematic review, we investigated the available evidence about the prevalence of TMD signs in children and adolescents. The meta-analysis results showed the prevalence of clinical signs of TMJ disorders to be approximately 16.0%. This information is important for dentists, who can provide an early diagnosis of and recommend management for TMD signs. It is known that many children diagnosed with TMD will experience adaptative physiological changes during craniofacial growth and development.[19] In contrast, if a diagnosis occurs too late, as in adults, for example, this condition may cause an irreversible destruction of the TMJ's

TABLE

Summary of descriptive characteristics of included articles.

AUTHOR, YEAR	COUNTRY	SAMPLE SIZE, NO.	AGE RANGE, Y	SAMPLE CHARACTERISTICS	RDC/TMD*†	RESULTS	QUALITY ASSESSMENT
Gazit and Colleagues,[13] 1984	Israel	369	10-18	Random sample from a school	N	TMJ‡ sounds = 35.8%	Poor
Pahkala and Laine,[19] 1991	Finland	1,008	5-15	Random sample from a school	N	TMJ sounds = 6.3%	Good
Keeling and Colleagues,[22] 1994	United States	3,428	6-12	Convenience sample from a school	N	Joint sounds = 10.0% Click = 8.9% Crepitation = 1.0% Click and crepitation = 0.2%	Outstanding
Deng and Colleagues,[18] 1995	China	2,200	3-15	Convenience sample from a school	N	TMJ sounds (click or crepitation) = 13.3%	Moderate
Alamoudi and Colleagues,[15] 1998	Saudi Arabia	502	3-7	Random sample from a school	N	TMJ sounds = 7.8% Click = 7.6% Crepitation = 0.2%	Good
Thilander and Colleagues,[7] 2002	Colombia	4,724	5-17	Random sample from Public Dental Health Service	N	Click (palpable) = 9.3% Click (audible) = 0.7% Jaw lock = 1.3% Luxation = 0.4%	Good
Farsi,[16] 2003	Saudi Arabia	1,976	3-15	Random sample (from each area, 3 schools were included, using a stratified selection technique of the entire student population of the school)	N	TMJ sounds (click or crepitation) = 11.8% Limited mouth opening = 5.9%	Outstanding
Feteih,[17] 2006	Saudi Arabia	385	12-16	Random sample (stratified selection technique from 6 schools in different geographic locations)	N	TMJ sounds = 13.5% Limited mouth opening = 4.7%	Good
Winocur and Colleagues,[14] 2006	Israel	314	15-18	Random sample from a school	N	TMJ sounds = 42.7% Limited mouth opening = 1.6%	Moderate
Tecco and Colleagues,[21] 2011	Italy	1,134	5-15	Convenience sample from dental clinic at a university	Y	TMJ sounds = 4.0% Limited mouth opening = 1.1%	Good
Hirsch and Colleagues,[20] 2012	Germany	1,011	10-17	Random sample from a school (schools and classes were selected randomly)	Y	Click = 14.7% Jaw lock = 3.7%	Outstanding

* RDC/TMD: Research Diagnostic Criteria for Temporomandibular Disorders.
† When the authors of an included study declared that they used RDC/TMD, we gave the study a score of Y (yes); however, if the authors of an included study used similar methodology but did not declare that they used RDC/TMD, we gave the study a score of N (no).
‡ TMJ: Temporomandibular joint.

intracapsular structures and, thereafter, contribute to abnormalities in craniofacial development, pain in the TMJ region, and TMD.[24]

Internal TMJ displacement is defined as a mechanical failure related to improper positioning of the TMJ articular disk associated with a potential interference in normal mandibular excursive movements. A "pop" or "click" sound in opening and closing the mouth often indicates an anterior disk displacement with reduction. This intra-articular disorder is usually asymptomatic and unaccompanied by any other indication for TMD. Its prevalence in the population varies from 20.0% to 35.0%.[25]

While reporting on the prevalence of signs of TMD in children and adolescents, some investigators have reported different methods of evaluation, such as Helkimo dysfunction index[26] and the RDC/TMD protocol.[10] Used widely for diagnosing TMDs, the RDC/TMD protocol[10] has 2 parts: axis I focuses on TMD diagnoses and axis II focuses on biobehavioral factors. The objective of axis II is to provide diagnostic criteria for TMD with simple, clear, reliable, and valid operational definitions for the history, examination, and imaging procedures of physical diagnoses. Investigators have found that the reliability of the RDC/TMD protocol is satisfactory in adult populations[27,28]; investigators have demonstrated the validity and clinical utility of the RDC/TMD protocol for chidren and adolescents for axis I, but not completely for axis II.[29] Using the RDC/TMD protocol allows researchers to perform the physical examination with a simple and reliable methodology and then compare their results with the results other studies conducted by investigators who used the same protocol.

In our study, we included both primary studies whose investigators had used the RDC/TMD protocol, as well as primary studies whose investigators had not used RDC/TMD because the criteria had not yet been developed at the time they conducted their studies but who instead applied similar criteria to define TMJ disorders. Although RDC/TMD was created to record the signs and symptoms of TMD in adults only, there is no other validated methodology for evaluating TMD signs and symptoms in children or adolescents.

In 2014, the 1992 version of RDC/TMD[30] was updated to the Diagnositc Criteria for Temporomandibular Disorders (DC/TMD),[10] and we noted some differences between the two versions. First, the DC/TMD encourages the patient to describe his or her pain during the physical examination, which a patient (particularly a child or an adolescent) may not be familiar with describing in an articulate manner. Second, the DC/TMD requires the dentist to seek the functional or referred source of a patient's pain, which may be difficult to ascertain in a child or adolescent. Third, the DC/TMD has been associated with some differences in the criteria that make it more complicated to use when diagnosing disk disorders. Also, in relation to the taxonomy classification, the DC/TMD included the diagnosis of disk displacement with reduction, with intermittent locking. Although now the DC/TMD for TMJ disorders is the most appropriate tool for dentists to use, because it was published in 2014, dentists could be prevented from finding original studies whose investigators have already used this specific diagnostic tool.

In this systematic review, we considered only articles whose investigators had a minimum study population of 300 participants. Three hundred is a minimum required sample size to estimate prevalence, given a known prevalence of 40%[6] and a sampling error of 5%.[31,32] To decrease the risk of bias, we excluded studies whose investigators had used convenience samples extracted from patients in treatment in dental clinics or in a hospital. We established this criteria to avoid or decrease bias across studies, maintain homogeneity of the results, and make it easier to find comparisons among studies. Some studies' investigators evaluated patients' TMJ sounds on palpation, and others recorded patients' TMJ sounds by using a stethoscope. Frequently, the number of TMJ sounds recorded when using a stethoscope is higher than the number of sounds recorded on palpation owing to the fact that a clinician can easily detect even a minor sound.[15] In this regard, the investigators of 1 study[24] reported a prevalence of 52.5% of TMJ sounds recorded by using a stethoscope. For clinical proposes, if a clinician suspects intra-articular pathology or arthritis in a patient, the clinician should consider consulting with a TMJ specialist or rheumatologist to determine the usefulness of conducting imaging studies, such as a screening panoramic radiograph and a contrast-enhanced magnetic resonance imaging.[33]

In this systematic review, through the meta-analysis, we recorded a prevalence of 15.5% for at least 1 sign of TMJ disorder (click or crepitation on palpation). Also, it was possible for us to observe that, in studies whose investigators considered a sample of patients aged 10 to 18[13,14] years, the prevalence of TMJ sounds increased with the patient's age.

TMD is a complex problem that involves multiple symptoms, and it may be secondary to other diseases with osseous findings. For dentists treating children with TMJ signs and symptoms, it is important to screen for juvenile idiopathic arthritis (JIA) to determine whether JIA could be a differential diagnosis. Children with JIA have a high incidence of TMJ involvement and may have other involved joints.[34] Magnetic resonance imaging findings can be indicative of early degenerative changes.[33] Typically, JIA involves a high level of inflammation leading to early degenerative joint changes and possible occlusal changes.[34] Clinicians should recommend that a pediatric rheumatologist and an oral surgeon evaluate these patients and manage their care. Indeed, for comparison purposes, clinicians should consider the results

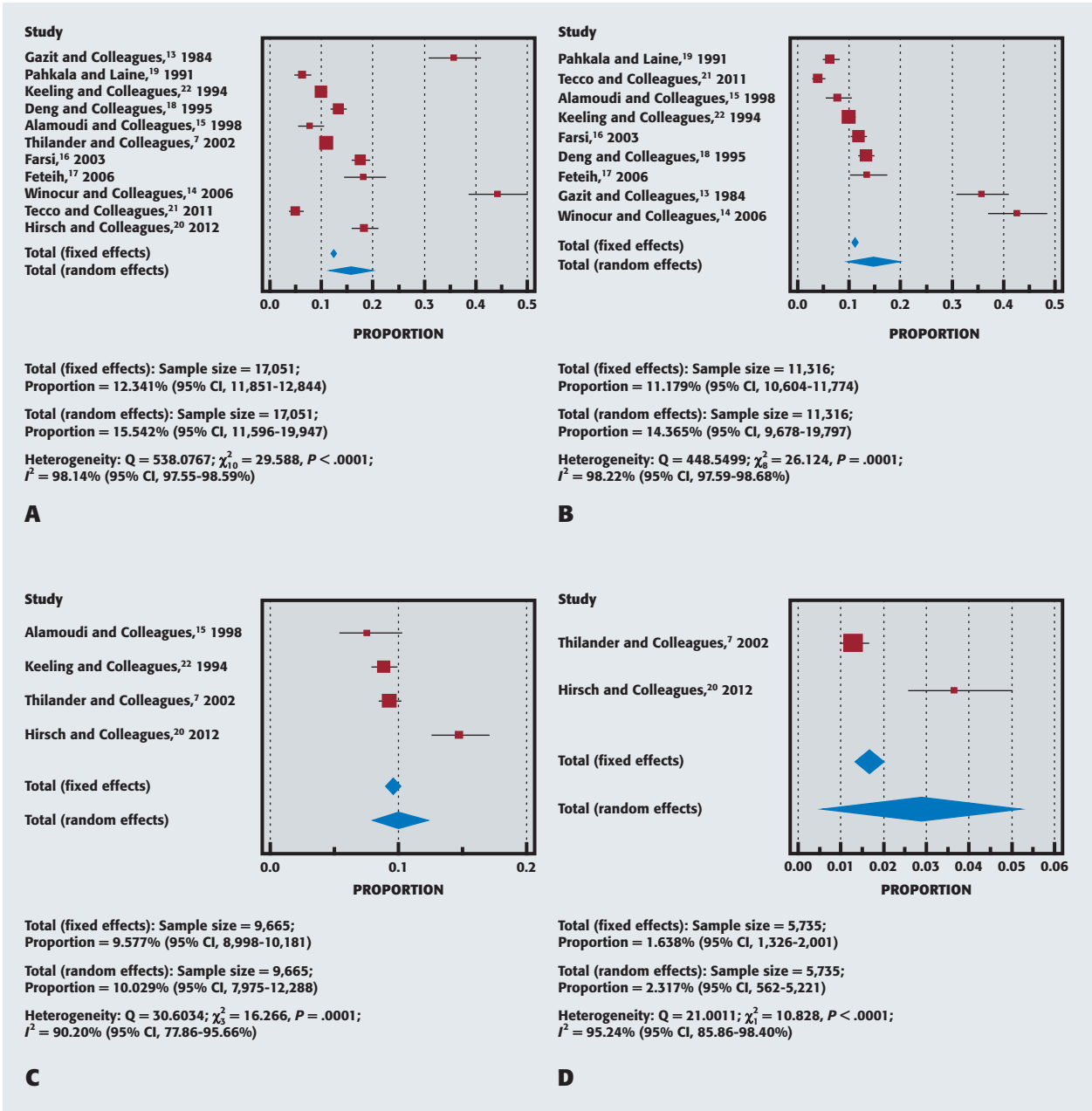

Figure 2. Prevalence of clinical temporomandibular joint (TMJ) signs. Results from 2 types of meta-analyses: fixed and random-effects. **A**. Forest plot for overall prevalence. Sample = 17,051. **B**. Forest plot for prevalence of TMJ sounds. Sample = 11,316. **C**. Forest plot for prevalence of click. Sample = 9,665. **D**. Forest plot for prevalence of jaw lock. Sample = 5,735. CI: Confidence interval.

of a previously published study that showed that the mean maximal incisal opening in 2- to 3-year-old children with no TMJ signs and symptoms is approximately 40 millimeters and increases, on average, 4 mm every 2 years.[35]

These research results can help to establish the need for treatment and to demand the data related to the prevalence of TMD. This procedure is essential in qualifying TMD in terms of planning oral health care and health care programs.[4] Furthermore, the results of this review should alert dentists about the importance of looking for TMJ signs in children and adolescents and considering these signs in the differential diagnosis of facial pain–related complaints. Also, the findings of TMJ

sounds or locking per se do not constitute indications for treatment; clinicians should investigate further to determine additional details of a patient's history, examination findings, and imaging to establish the treatment needs.

The selected studies were conducted in 8 countries (Israel,[13,14] Saudi Arabia,[15-17] Colombia,[7] China,[18] Finland,[19] Germany,[20] Italy,[21] and the United States[22]). Future research to investigate the global prevalence of signs of TMJ disorders is necessary.

Limitations. Our meta-analysis had some limitations. We tried to minimize bias across studies and obtain maximal homogeneity among studies by using appropriate eligibility and exclusion criteria and by trying to select only studies that had similar sample sizes and used similar methods of clinical examination. Nonetheless, in the results of our systematic review, we found considerable variation related to prevalence as reported by the authors of the included studies. This variation among the studies should occur owing to the different characteristics of the included studies (that is, different ages, age ranges, sample size, ratio of sex distribution) and not because of the methodology applied.

CONCLUSIONS

The prevalence of clinical signs of temporomandibular joint disorders in children and adolescents was approximately 16%. The prevalence of TMJ sounds was approximately 14%. The most prevalent sign was clicking, followed by jaw locking. Other signs were infrequent or not reported. ■

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: http://dx.doi.org/10.1016/j.adaj.2015.07.017.

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eTABLE 1

Search terms and databases.*

DATABASES	SEARCH TERMS
Cochrane Library, Embase, MEDLINE, PubMed	(disease or diseases or dysfunction or dysfunctions or disorder or disorders or derangement or derangements) and (temporomandibular or tmj or "temporomandibular joint") and (signs or sound or sounds or noise or noises or click or clicking or pop or popping or snap or snapping or crepitus or hypermobility or hypomobility or "jaw lock" or "limited mouth opening" or "limited jaw opening") and (prevalence or frequency[Title/Abstract]) and (child or children or childhood or adolescent or adolescents or adolescence or teenager or teenagers or infant or infants or pediatrics or pediatrics or paediatric or paediatrics)
LILACS	(prevalência or prevalence [words]) and (disfunção temporomandibular or disfuncion temporomandibular or temporomandibular dysfunction [words]) and (crianças or niños or children [words])
Google Scholar	("temporomandibular disorders") and (prevalence) and (children or adolescent)

* The authors searched the electronic databases from their starting coverage date through October 15, 2014.

eTABLE 2

Articles excluded and the reasons for exclusion.

AUTHOR, YEAR	REASONS FOR EXCLUSION*
Abdel-Hakim,[e1] 1983	5
Abdel-Hakim and Colleagues,[e2] 1996	5
Agerberg and Carlsson,[e3] 1972	4, 5
Ajanovic and Colleagues,[e4] 2013	10
Akeel and Al-Jasser,[e5] 1999	10
Bakke and Colleagues,[e6] 1995	10
Bonjardim and Colleagues,[e7] 2005	8
Catapano and Colleagues,[e8] 1990	5
Collesano and Colleagues,[e9] 1988	5
Conti and Colleagues,[e10] 1996	5
Conti and Colleagues,[e11] 2003	10
Cooper and Kleinberg,[e12] 2007	5
Cortese and Biondi,[e13] 2009	7
De Boever and Van Den Berghe,[e14] 1987	8
De Vis and colleagues,[e15] 1984	8
Dodic,[e16] 2004	5
Dunzl and Besch,[e17] 1983	11
Egermark-Eriksson and Colleagues,[e18] 1981	8
Emodi-Perlman and Colleagues,[e19] 2012	10
Gavish and Colleagues,[e20] 2000	10
Goddard,[e21] 1995	8
Grosfeld and Czarnecka,[e22] 1977	8
Grosfeld and Colleagues,[e23] 1985	8
Heikinheimo and Colleagues,[e24] 1989	8
Henrikson and Colleagues,[e25] 1999	10
Henrikson and Colleagues,[e26] 2000	10
Hirata and Colleagues,[e27] 1992	10
Howell and Morel,[e28] 1993	10
Huddleston Slater and Colleagues,[e29] 2007	9
Jagger and Wood,[e30] 1992	5
Jagger and Colleagues,[e31] 2004	5
Kalaykova and Colleagues,[e32] 2011	10
Kampe and Colleagues,[e33] 1987	8
Katzberg and Colleagues,[e34] 1996	5
Katzberg and Colleagues,[e35] 1996	3
Khedr and Colleagues,[e36] 2010	5

* Studies were excluded for the following reasons: 1. Reviews, letters, conference abstracts, and personal opinions; 2. Studies in which the sample included patients with craniofacial anomalies, genetic syndromes, or neuromuscular diseases; 3. Studies in which the sample included orthodontic patients or patients who had an indication for orthognathic surgery; 4. Studies in which the interview was not conducted in person (for example, by phone or by mail); 5. Studies in adults; 6. Studies whose investigators investigated only muscular symptoms like headache; 7. Studies in which the interview, the examination, or both was not done by a dentist; 8. Studies whose investigators did not report an interview or exam conducted with exactly the same protocol as Research Diagnostic Criteria for Temporomandibular Disorders; 9. Studies with a convenience sample extracted from patients in treatment in dental clinics or hospital; 10. Studies with sample with fewer than 300 participants; 11. Studies not available.

eTABLE 2 (CONTINUED)

AUTHOR, YEAR	REASONS FOR EXCLUSION*
Kirveskari and Colleagues,[e37] 1992	8
Kirveskari,[e38] 2001	5
Kitai and Colleagues,[e39] 1997	9
Köhler and Colleagues,[e40] 2009	8
Kononen and Colleagues,[e41] 1987	8
Kononen and Nyström,[e42] 1993	10
List and Colleagues,[e43] 1999	9
Liu and Tsai,[e44] 1996	5
Magnusson and Colleagues,[e45] 1985	8
Magnusson and Colleagues,[e46] 1994	10
Magnusson and Colleagues,[e47] 2000	10
Magnusson and Colleagues,[e48] 2005	6
Meijer van Putten,[e49] 1996	11
Manfredini and Colleagues,[e50] 2006	5
Motegi and Colleagues,[e51] 1992	9
Motohashi and Colleagues,[e52] 2009	8
Moyaho-Bernal and Colleagues,[e53] 2010	10
Muhtaroðullarý and Colleagues,[e54] 2004	8
Nielsen and Melsen and Colleagues,[e55] 1988	8
Nielsen and Colleagues,[e56] 1989	8
Nilner,[e57] 1983	8
Nilner,[e58] 1986	8, 9
Nilsson,[e59] 2007	6
Ogura and Colleagues,[e60] 1985	8
Ohno and Colleagues,[e61] 1988	8
Okeson,[e62] 1989	1
Paesani and Colleagues,[e63] 1999	8
Pereira and Colleagues,[e64] 2009	10
Pereira and Colleagues,[e65] 2009	10
Pilley and Colleagues,[e66] 1992	7
Rao and Colleagues,[e67] 1993	8
Rieder and Colleagues,[e68] 1983	5
Rieder and Martinoff,[e69] 1983	5
Riolo and Colleagues,[e70] 1987	5, 8
Runge and Colleagues,[e71] 1989	8
Sadowsky and Colleagues,[e72] 1991	3
Seckin and Colleagues,[e73] 2005	8
Sánchez-Pérez and Colleagues,[e74] 2013	8
Sonmez and Colleagues,[e75] 2001	8
Sonnesen and Colleagues,[e76] 1998	10
Stockstill and Colleagues,[e77] 1998	8
Szentpetery and Colleagues,[e78] 1986	5
Takada and Colleagues,[e79] 1971	5
Tanne and Colleagues,[e80] 1993	2
Torii,[e81] 2011	10
Tuerlings and Limme,[e82] 2004	8
Verdonck and Colleagues,[e83] 1994	8

eTABLE 2 (CONTINUED)

AUTHOR, YEAR	REASONS FOR EXCLUSION*
Vierola and Colleagues,[e84] 2012	9
Wahlund and Colleagues,[e85] 1998	10
Wanman and Agerberg,[e86] 1986	10
Wanman and Agerberg,[e87] 1990	10
Weiler and Colleagues,[e88] 2010	10
Weiler and Colleagues,[e89] 2013	10
Westling and Mattiasson,[e90] 1991	10
Westling and Mattiasson,[e91] 1992	8
Widmalm and Colleagues,[e92] 1995	8
Widmalm and Colleagues,[e93] 1995	8
Widmalm and Colleagues,[e94] 1999	8
Wigdorowicz-Makowerowa and Colleagues,[e95] 1979	5
Williamson,[e96] 1977	9
Winocur and Colleagues,[e97] 2000	10
Winocur and Colleagues,[e98] 2009	5
Xu,[e99] 1989	5

eTABLE 3

Risk of bias across studies.*

ITEM	ALAMOUDI AND COLLEAGUES[e100]	DENG AND COLLEAGUES[e101]	FARSI[e102]	FETEIH[e103]	GAZIT AND COLLEAGUES[e104]
Ethics Commission Approval	0	0	0	0	0
Recruitment Procedure	2	0	2	2	0
Response Rate Enough?	0	0	2	2	0
Is the Rate Taken Into Account?	0	0	NA†	NA	0
Power	2	2	2	0	0
Target Population Clearly Defined?	1	1	2	2	1
Probability Sampling Used?	2	0	2	2	0
Do the Respondents Match the Target?‡	0	0	2	2	0
Standardized Data-Collection Methods?	2	2	2	2	2
Reliable Survey Instruments?	1	1	1	1	0
Valid Survey Instruments?	1	1	1	1	1
Were Special Features Accounted For?	0	0	1	0	0
Satisfactory Confidence Intervals?	1	0	0	0	0
Total Quality Score§	**12**	**7**	**15**	**12**	**4**

* Total score and quality classification according Giannakopoulos and colleagues.[e111]
† NA: Not applicable.
‡ Sum of the following 2 items: Response rate enough? Is the rate taken into account?
§ Q1 (0-4) = poor; Q2 (5-9) = moderate; Q3 (10-14) = good; Q4 (15-19) = outstanding.

eTABLE 3 (CONTINUED)

HIRSCH AND COLLEAGUES[e105]	KEELING AND COLLEAGUES[e106]	PAHKALA AND LAINE[e107]	TECCO AND COLLEAGUES[e108]	THILANDER AND COLLEAGUES[e109]	WINOCUR AND COLLEAGUES[e110]
1	0	0	1	0	0
2	2	0	0	2	2
2	2	0	0	0	0
1	NA	0	0	0	0
2	2	2	2	2	0
2	2	2	1	2	2
2	2	0	0	0	0
3	2	0	0	0	0
2	2	2	2	2	2
2	1	1	2	1	0
2	1	1	2	1	1
1	1	1	1	1	0
1	1	1	1	0	1
19	**16**	**10**	**12**	**11**	**8**

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